

Alternative Cleaning Technologies

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Purpose

Evaluate the durability of the flame retardant upon the flame retarded wool-rich upholstery in the seat fire blocking test after 10 cleanings in GreenEarth[®] DF-2000[®] and Professional Wet Cleaning on three commonly used fire hardened foams; i.e.,---Chestnut Ridge, Metzeler, and Dax. Where possible, the test results were compared to the Phase II research which incorporated the same cleaning systems, and fabrics used in the dry cleaning portion and fire blocked foams.

Test Protocol

Vendors qualified to BMS 8-236, upholstery, submitted flame retardant upholstery for evaluation in DF-2000® and GreenEarth® dry cleaning processes and professional Wet Cleaning.

Boeing asked one vendor to weave more than 100 meters of upholstery for distribution to the participating vendors wanting to apply their own shrink resistant/flame retardant finish for the Wet Cleaning tests. This would identify which vendors had viable shrink resistant/flame retardant finishes without introducing variables related to the fabric's construction.

The 'As Received' tests were done in an aviation certification approved laboratory. After 10 cleanings in each method, the percent change in burn length and weight loss were compared.

Test Protocol

A statistician was hired to determine the significant correlation between the three cleaning methods and three foams.

Each test was recorded on video tape. A sign for each test identified the cleaning type, vendor and foam.

All of the materials were fabricated into test cushions by a professional upholsterer.

All the seat fire blocking tests were conducted at the FAA Technical Center Burn Facility in July 2001.



DF-2000®

GreenEarth®

Wet Cleaning

Metzeler Foam

Dax Foam

Chestnut Ridge Foam

DF-2000[®]

GreenEarth[®]

Wet Cleaning

Chestnut Ridge Foam

	Test1	Test 2	Test 3
72290	P	P	P
J10247D	P	P	P
46'452	P	P	P
46'473	P	P	P
226.01	P	P	P

Dax Foam

	Test1	Test 2	Test 3
72290	F	F	P
J10247D	F	F	F
46'452	F	F	F
46'473	F	F	F
226.01	F	F	F

Metzeler Foam

	Test1	Test 2	Test 3
72290	P	P	P
J10247D	P	P	P
46'452	P	F	P
46'473	P	F	P
226.01	P	P	P

Metzeler Foam

Dax Foam

Chestnut Ridge Foam

DF-2000[®]

GreenEarth[®]

Wet Cleaning



DF-2000®

GreenEarth®

Wet Cleaning



Chestnut Ridge Foam

	Test1	Test 2	Test 3
72290	P	P	P
J10247D	P	P	P
46'452	P	P	P
46'473	P	P	P
226.01	P	P	P

Dax Foam

	Test1	Test 2	Test 3
72290	P	P	P
J10247D	F	F	F
46'452	F	F	F
46'473	F	F	F
226.01	F	F	F

Metzeler Foam

	Test1	Test 2	Test 3
72290	P	P	P
J10247D	P	P	P
46'452	P	F	P
46'473	P	F	P
226.01	P	P	P

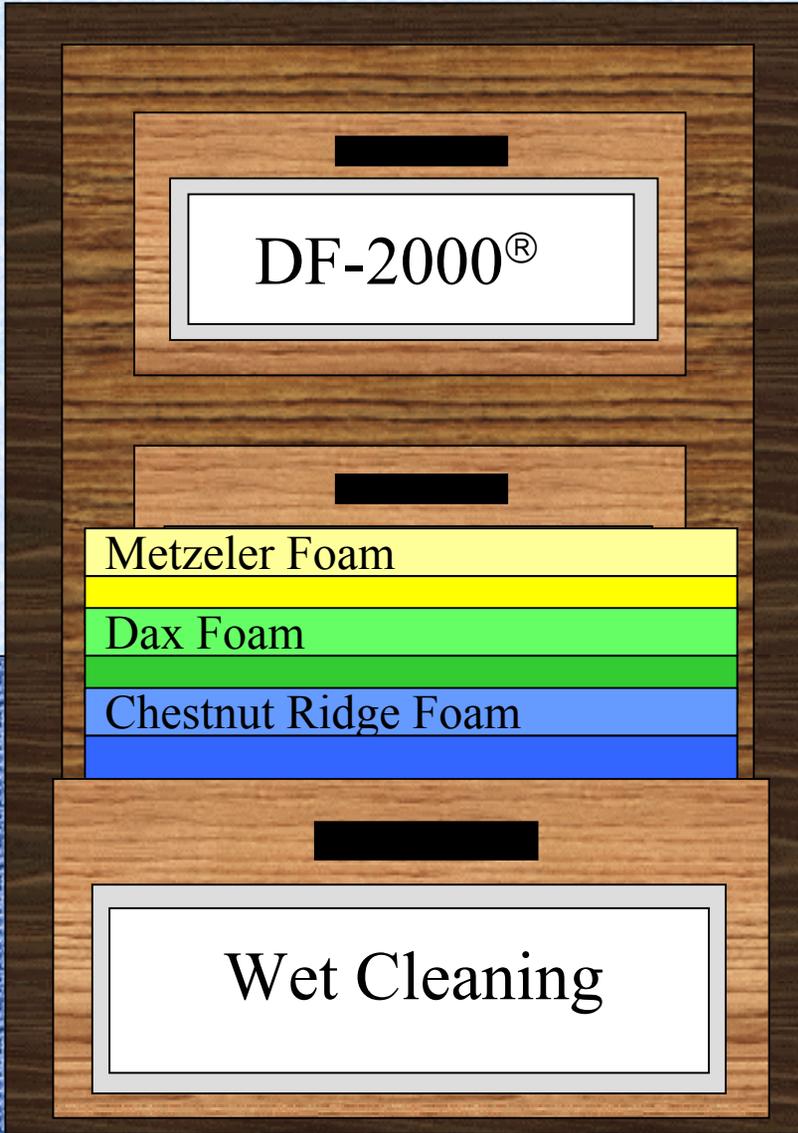




DF-2000®

GreenEarth®

Wet Cleaning



DF-2000®

The diagram shows a vertical cabinet with a wood-grain finish. At the top is a closed drawer with a black handle. Below it is a white label with the text 'DF-2000®'. Underneath the label is another closed drawer with a black handle. Below that is a stack of four foam layers: a yellow layer labeled 'Metzeler Foam', a green layer labeled 'Dax Foam', a blue layer labeled 'Chestnut Ridge Foam', and a white layer. At the bottom is a larger open drawer with a black handle, containing a white label with the text 'Wet Cleaning'.

Metzeler Foam

Dax Foam

Chestnut Ridge Foam

Wet Cleaning

Chestnut Ridge Foam

	Test1	Test 2	Test 3
12411-310 F1	P	P	P
12411-310 F2	P	P	P
46'490	P	P	P
BWJ/7846	F	P	F
VA 231	P	P	P
2330/D166	P	P	P

Dax Foam

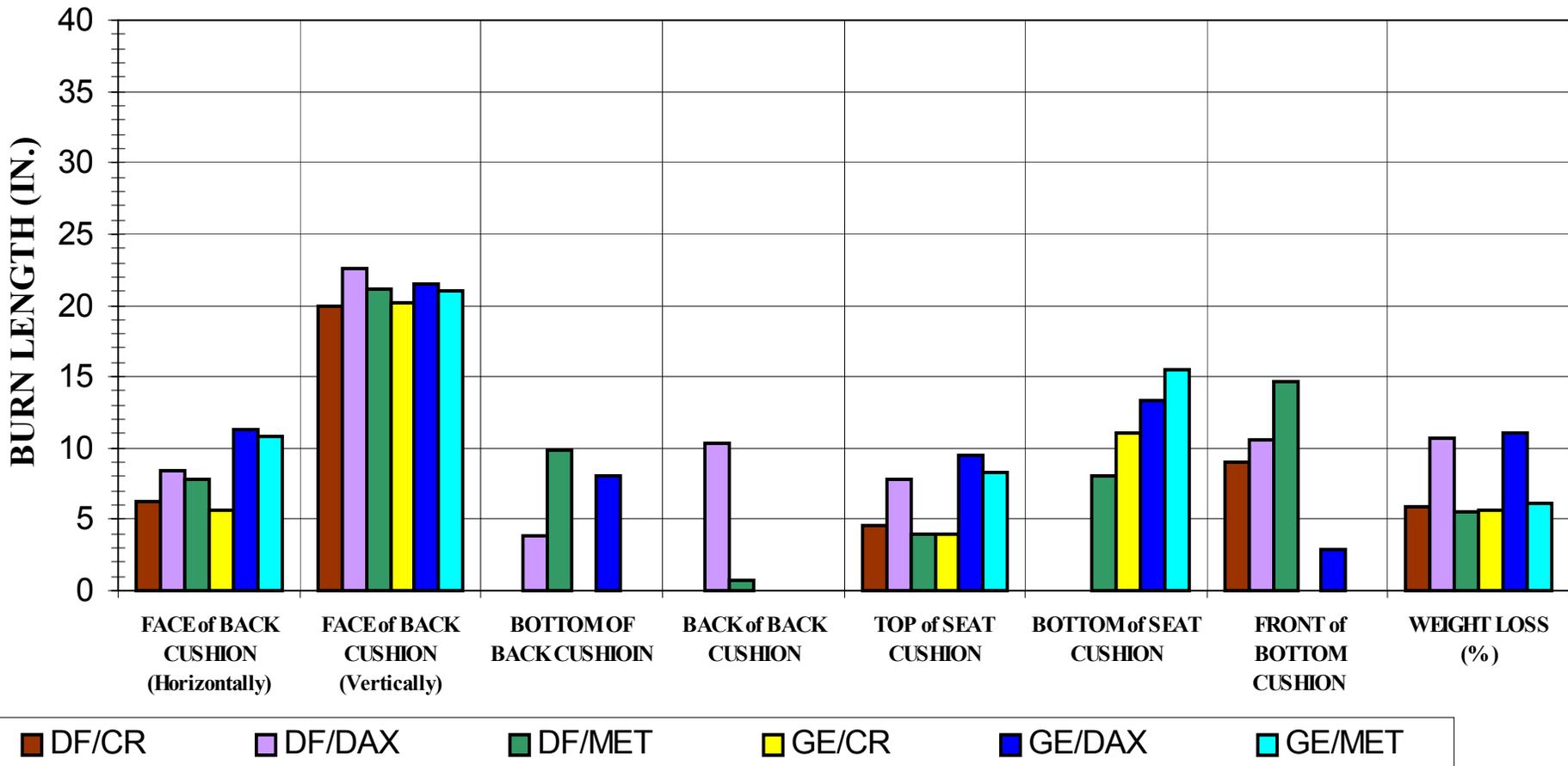
	Test1	Test 2	Test 3
12411-310 F1	F	F	F
12411-310 F2	F	F	F
46'490	F	F	F
BWJ/7846	F	F	F
VA 231	F	F	F
2330/D166	F	F	F

Metzeler Foam

	Test1	Test 2	Test 3
12411-310 F1	P	P	P
12411-310 F2	P	P	P
46'490	P	P	P
BWJ/7846	P	P	F
VA 231	P	P	P
2330/D166	P	P	F

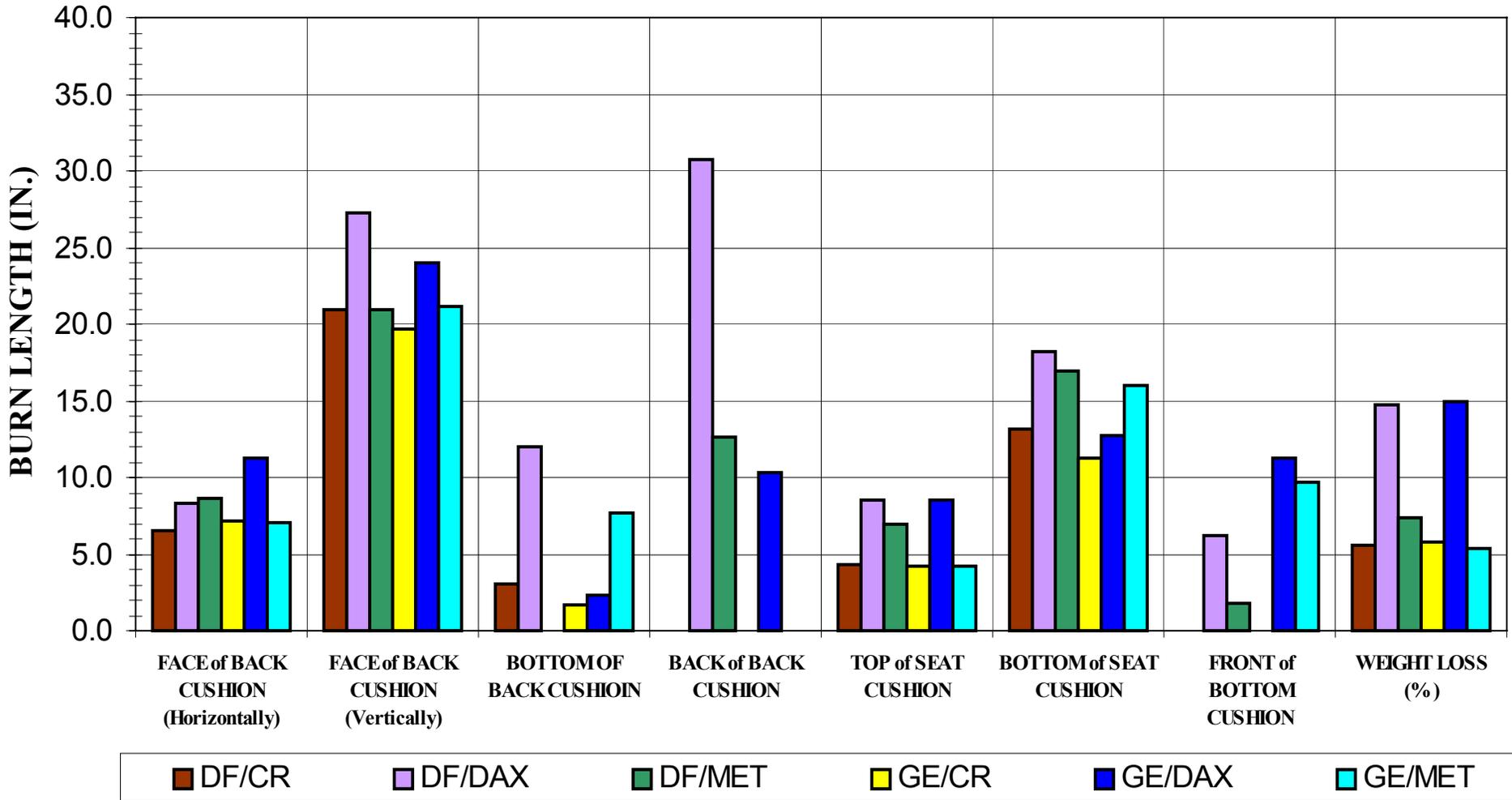
Alternative Cleaning Technologies
Seat Fireblocking Test Results for 72290-080
After 10 Dry Cleanings

Figure 1



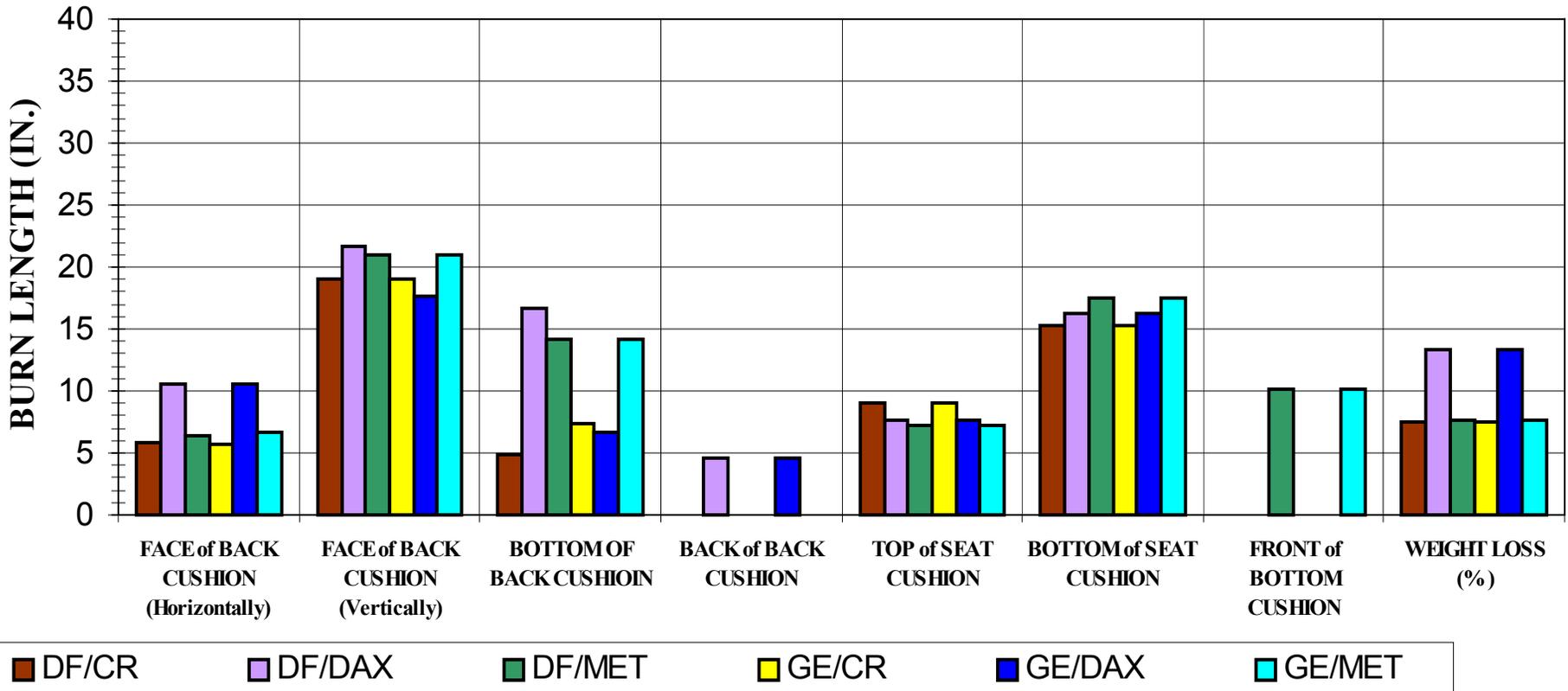
**Alternative Cleaning Technologies
Seat Fireblocking Test Results for J10247D
After 10 Dry Cleanings**

Figure 2



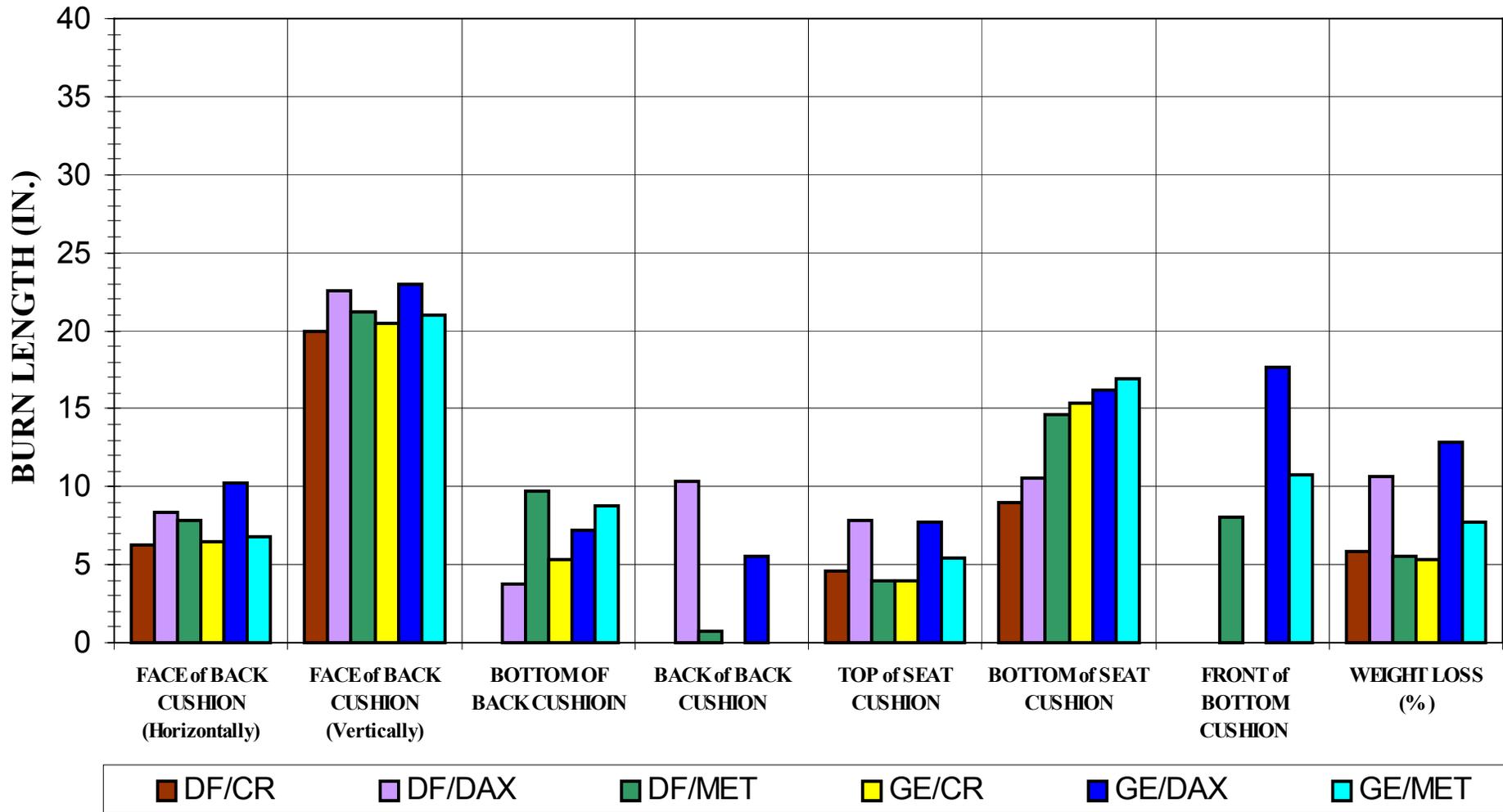
Alternative Cleaning Technologies
Seat Fireblocking Test Results for 46'452
After 10 Dry Cleanings

Figure 3



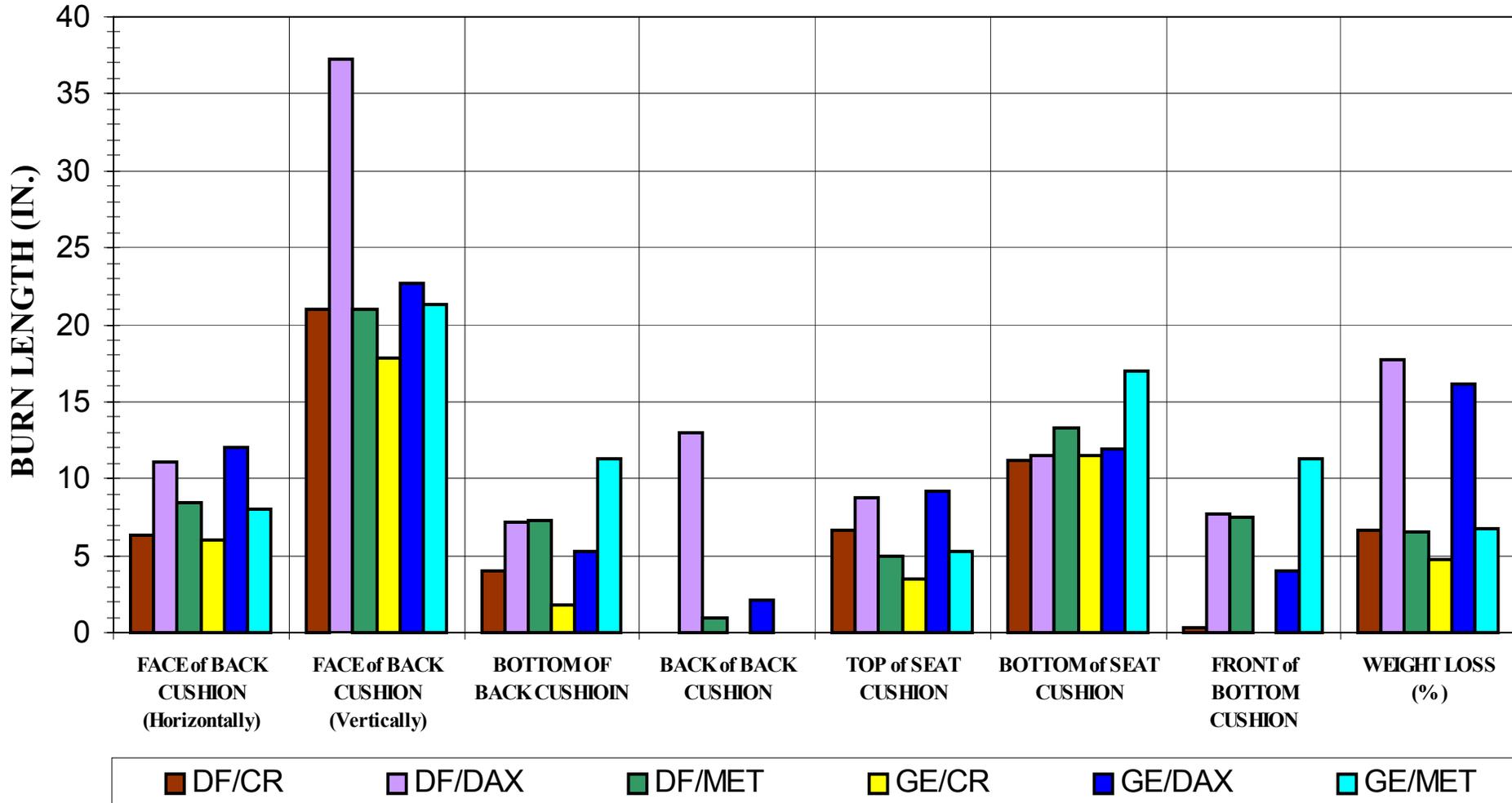
Alternative Cleaning Technologies
Seat Fireblocking Test Results for 46'473 100% Wool
After 10 Dry Cleanings

Figure 4



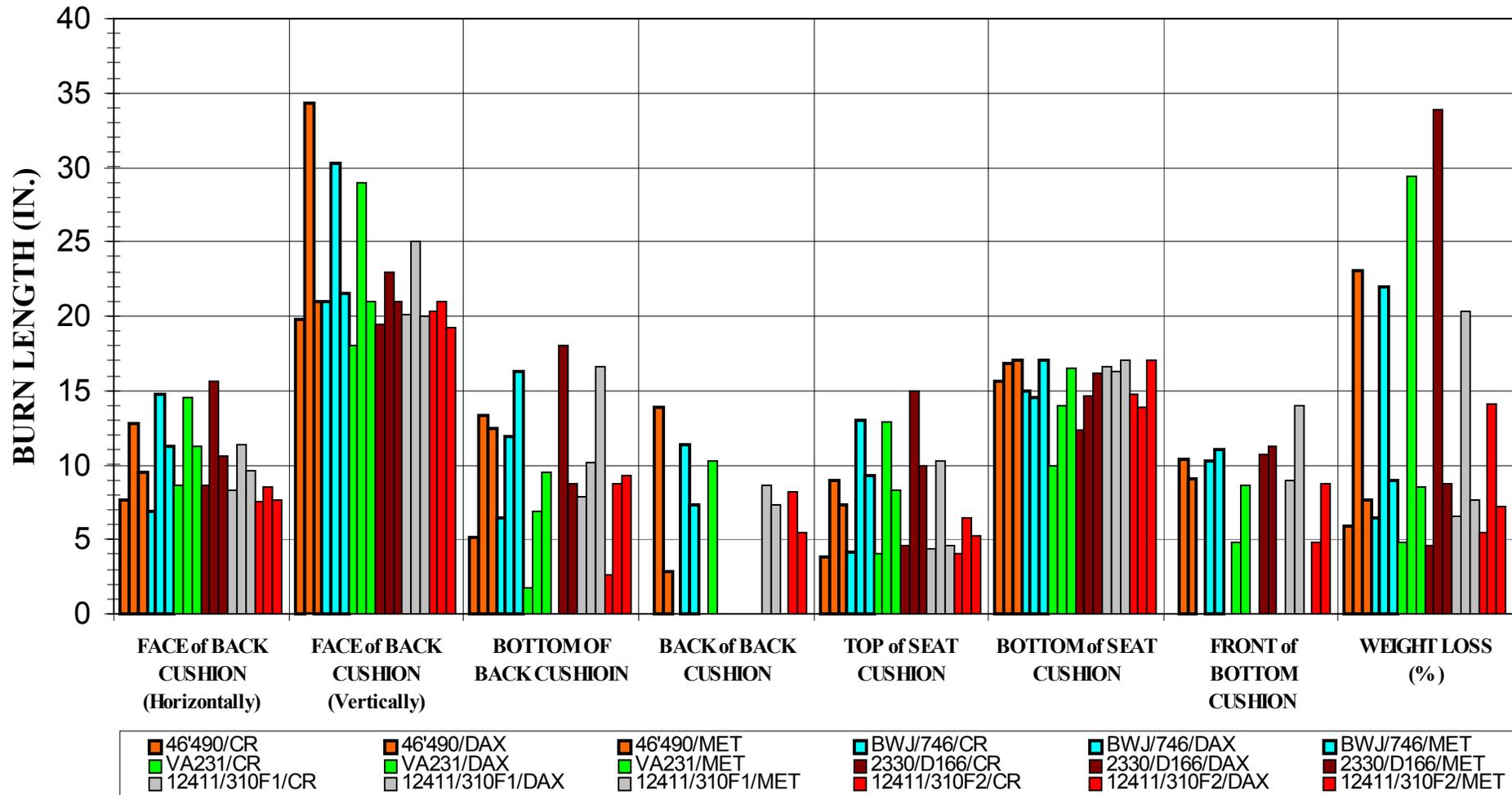
Alternative Cleaning Technologies
Seat Fireblocking Test Results for 226.01
After 10 Dry Cleanings

Figure 5



Alternative Cleaning Technologies Seat Fireblocking Test Results for After 10 Wet Cleanings

Figure 6

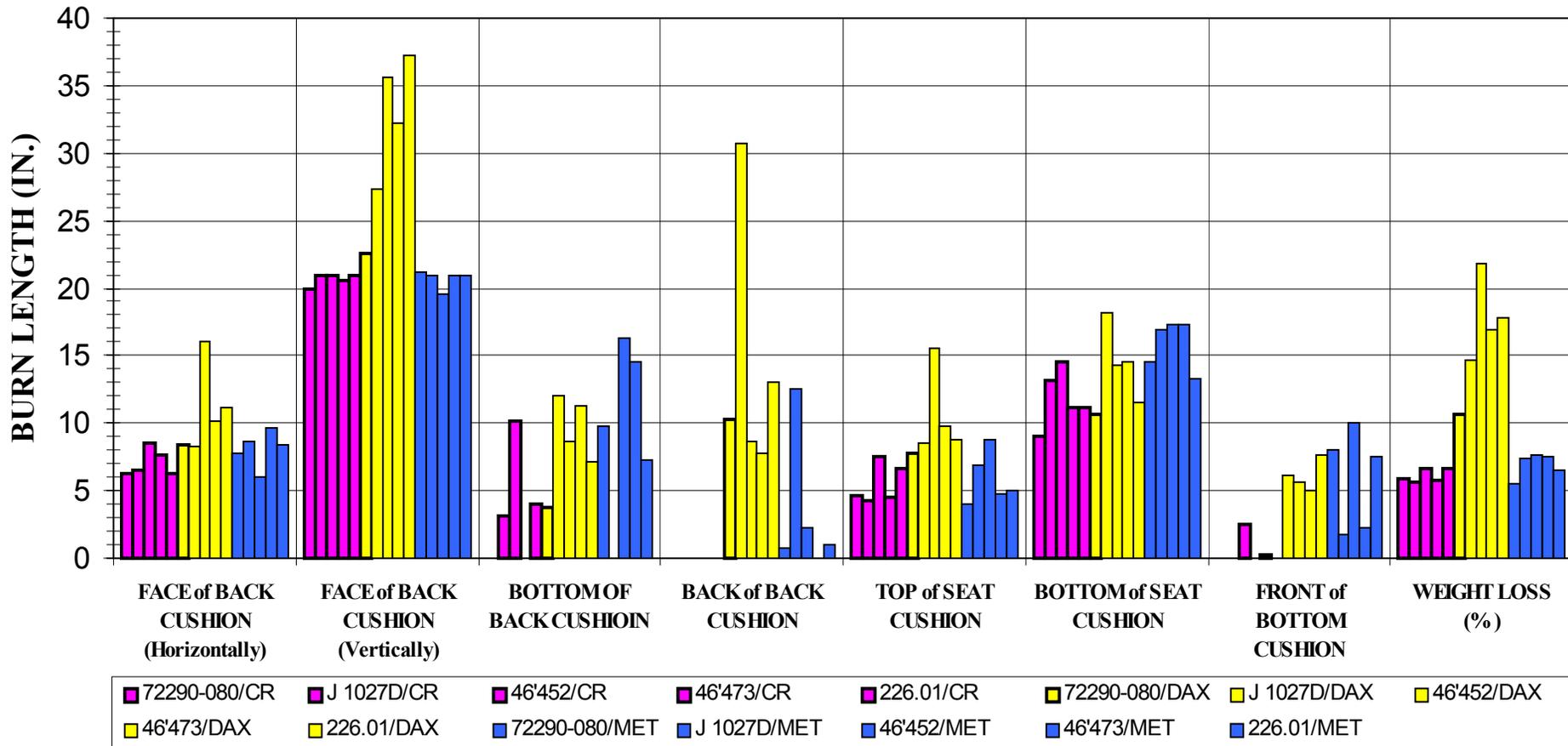


Alternative Cleaning Technologies

Seat Fireblocking Test Results After 10 Dry Cleanings

in DF-2000[®]

Figure 7

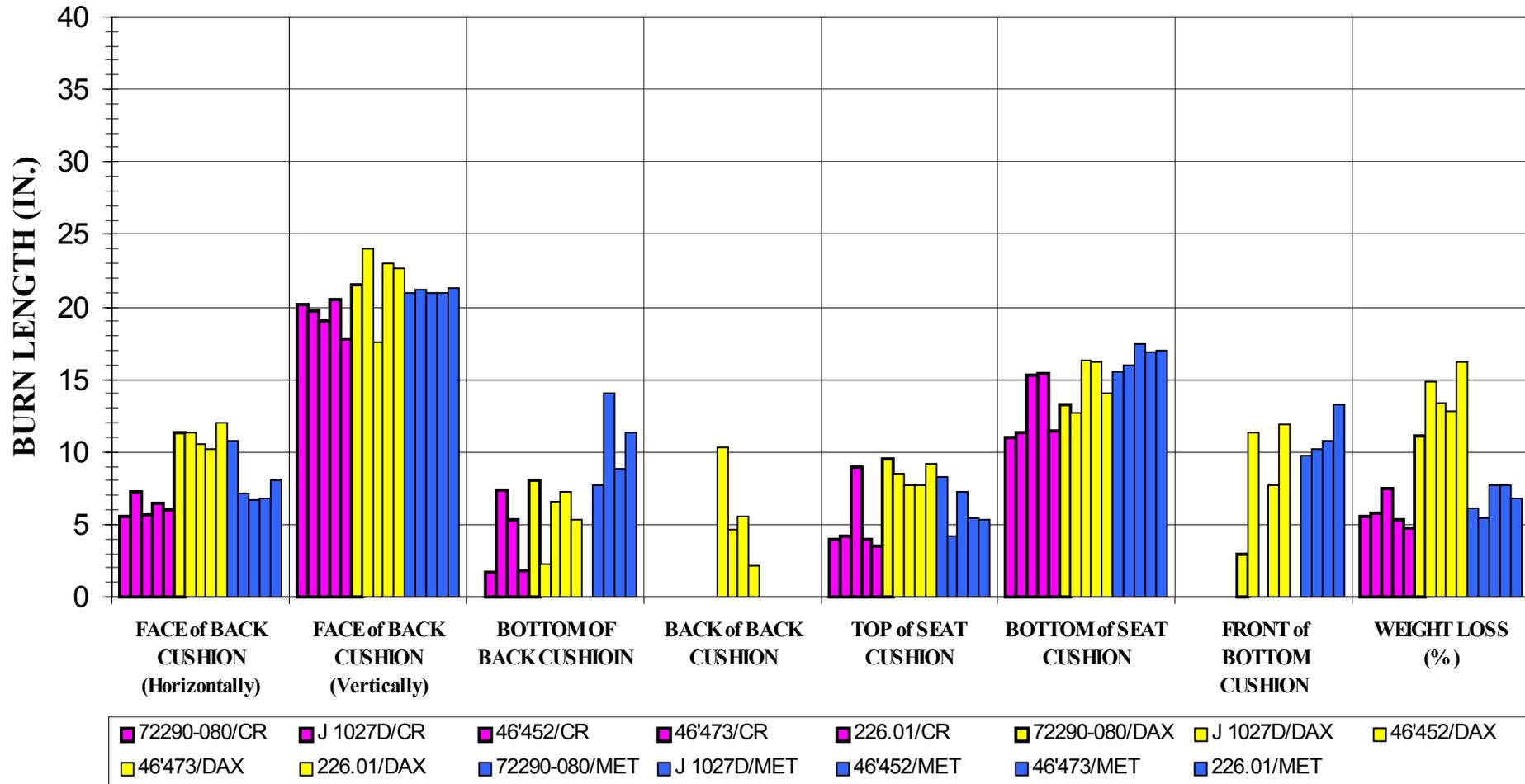


Alternative Cleaning Technologies

Seat Fireblocking Test Results After 10 Dry Cleanings

in GreenEarth[®] by Foam Vendor

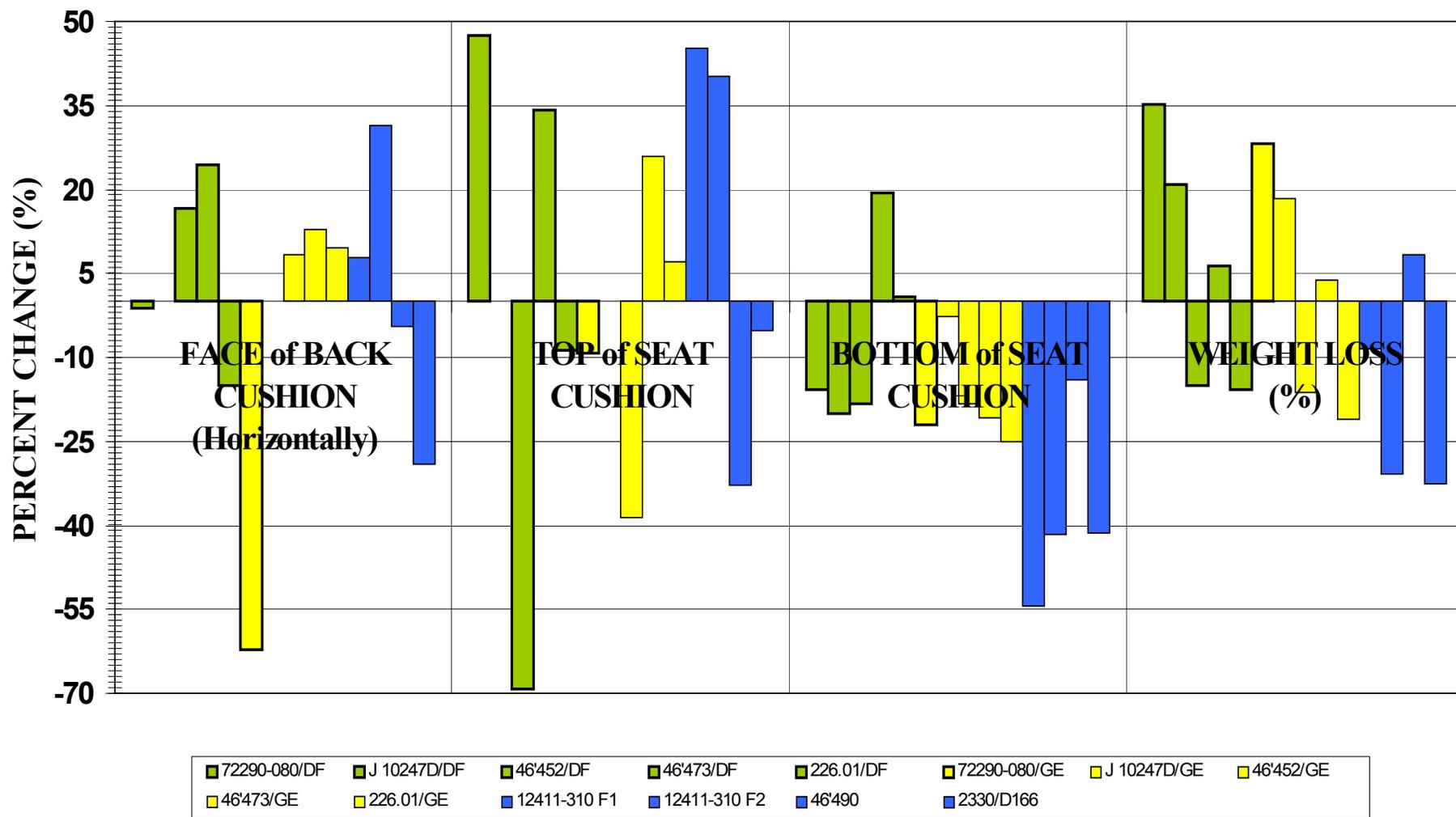
Figure 8



Alternative Cleaning Technologies

Percent Change in Burn Length After 10 Cleaning Cycles

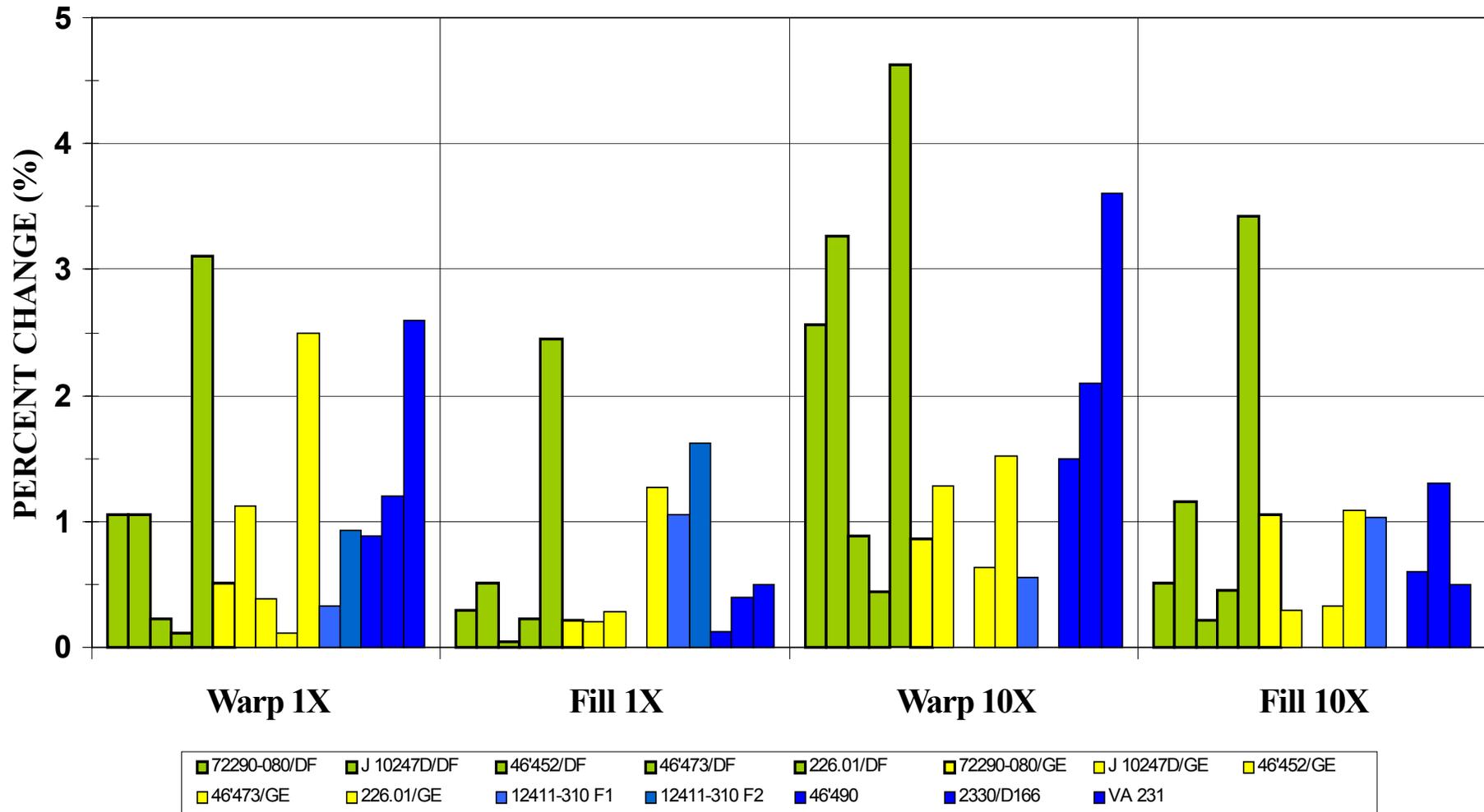
Figure 10



Alternative Cleaning Technologies

Percent Change in Dimensional Stability After 10 Cleaning Cycles

Figure 11



The Senior Technical Fellow Stipend

Goal: Optimize a dimensional stability finish compatible with flame retardant wool after 10 commercial laundry cycles.

A research contract was written between the Wool Research Organization of New Zealand and Boeing Commercial Airplane Group.

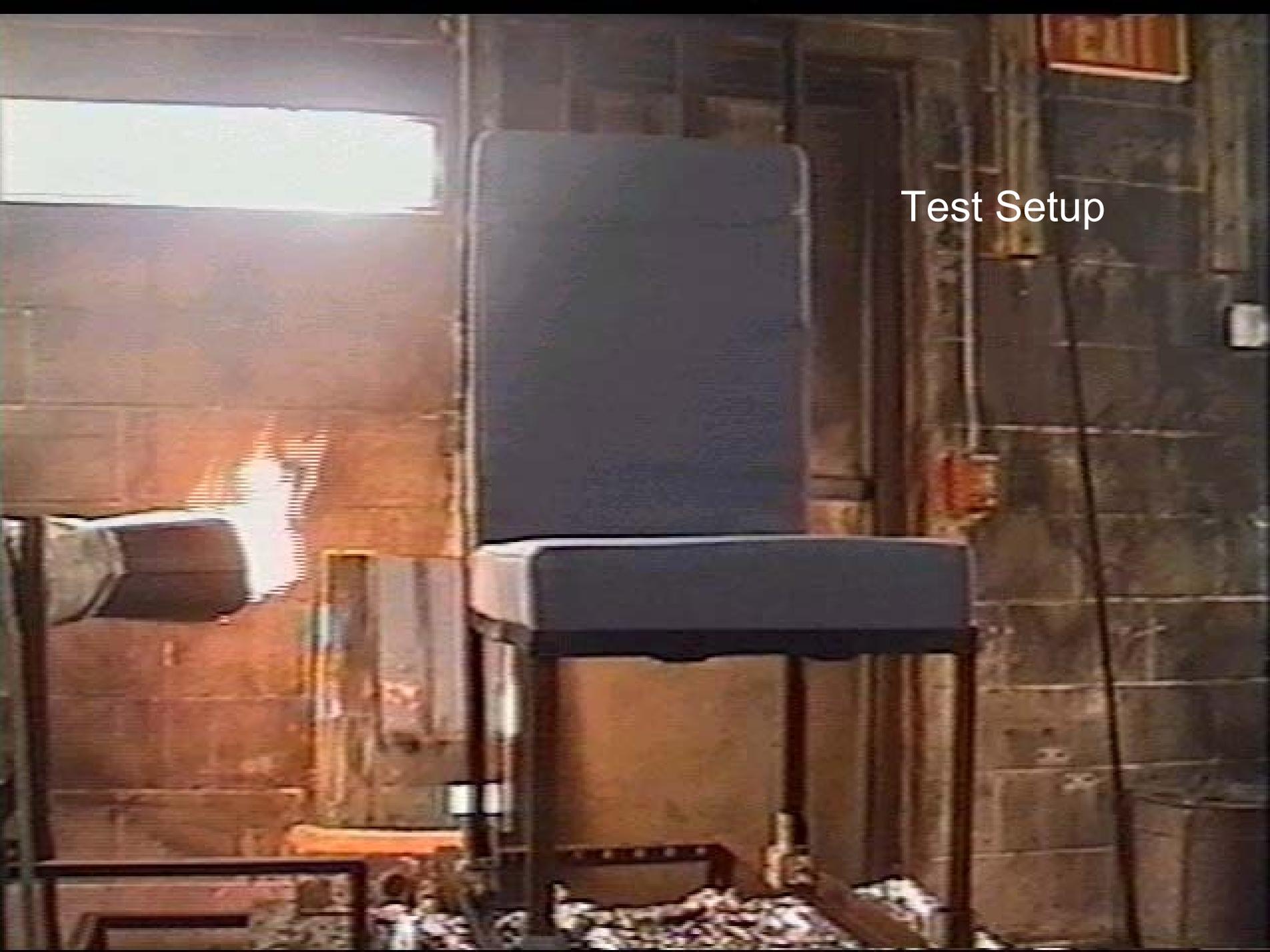
Weave 100 meters each of identical fabrics of 100% wool and 90/10% wool-nylon.

Three flame retardant/shrink resistant chemical formulations were evaluated in the seat fire blocking test on a fire hardened and a fire blocked foam selected by Boeing.

Evaluate stain removal capability in the optimized laundry cycle.

Study the advantages of stain blocker for flame retardant wool upholstery in aviation.





Test Setup

Burn 3

DF-2000 10X

46'452

DAX Foam

DATE: July 12, 2001

Test Identification

GreenEarth on
Metzeler Foam



GreenEarth on
Metzeler Foam



Same Fabric and Cleaning on Different Foam



DF-2000 Before
Back has Fallen



DF-2000 While
Back is Falling



DF-2000 After
Back Falling





Adhesive Burning
on Chestnut Ridge
Foam. Fabric Cleaned in
GreenEarth

Wet Cleaned Fabric
on Smoking Metzeler Foam



Wet Cleaned on
Chestnut Ridge
Foam





Back Hole in Foam
With Back Fabric Intact

Evaluating the
Burn Lengths



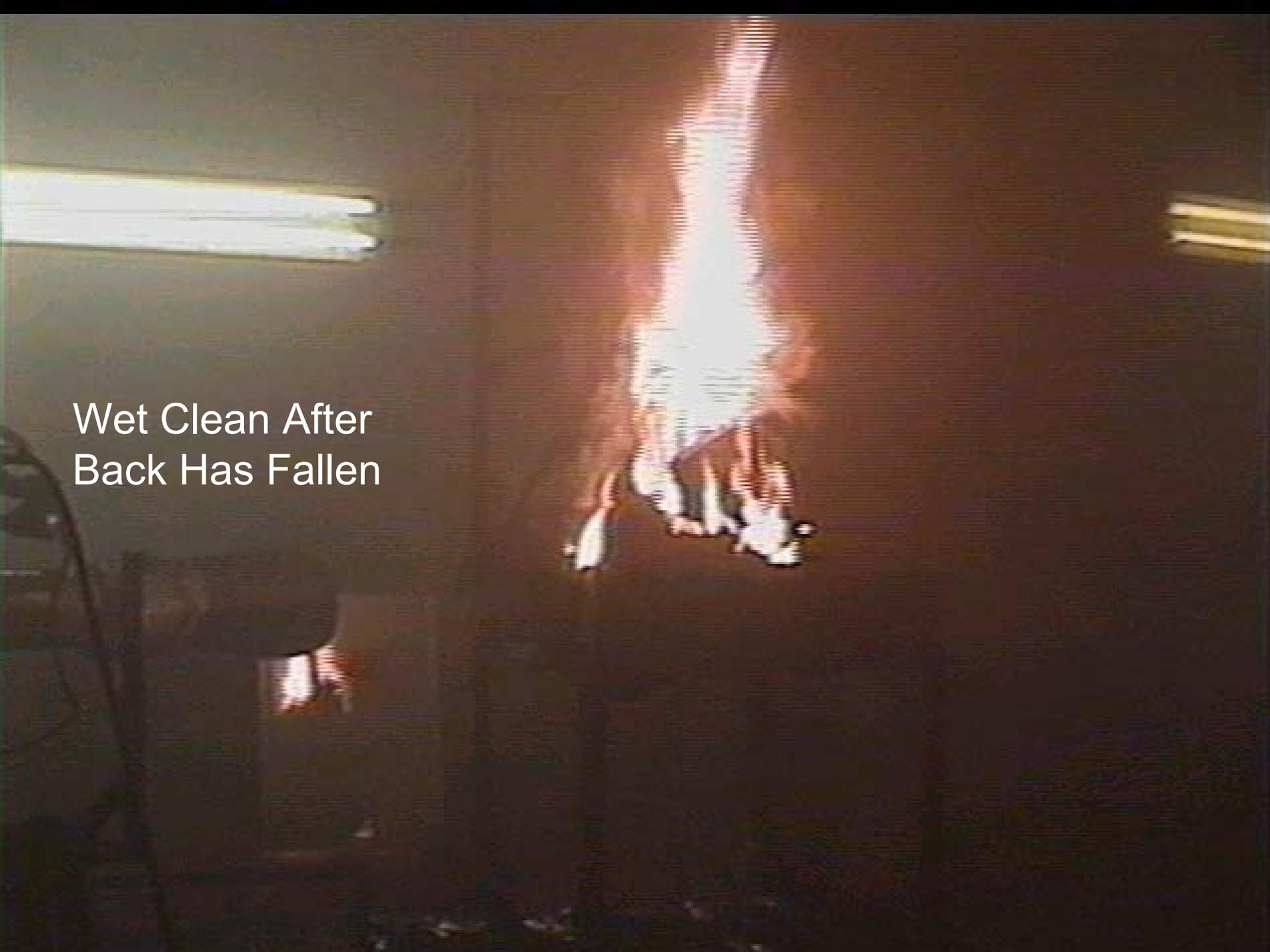
Wet Clean Before
Back has Fallen



Wet Clean While
Back is Falling



Wet Clean After
Back Has Fallen





The Bone Yard

Summary, Conclusions, and Goals

A cleaning method that does not involve perchloroethylene is needed for airlines worldwide.

Further work is needed to minimize upholstery shrinkage during cleaning.

In this study, seat fire blocking test results depended more on the seat cushion foam than on the cleaning method. The test results show that fire hardened foams need better consistency, and smoke generation needs to be reduced.

Fire propagated across the front and down the back of back cushions in several tests. Fire propagation down the back of the back cushion has not been previously encountered, and is not addressed in the pass/fail criteria.

Current flame retardant finishes, fabric blends, and fiber blending methods are different from those used in 1987 when the seat fire blocking test was implemented. Criteria for certification by similarity is based on 1987 technology, and may need to be reviewed.

Comparison of test results with the previous Phase II study was possible only for DF-2000, where all materials showed equal or significant improvement in burn lengths. After Phase II, the protocol for Wet Cleaning was changed, and the GreenEarth solvent was reformulated to avoid leaving a residue that caused seat fire blocking test failures.

